

## IS THERE A FIFTH INTERNATIONAL RADIOCARBON INTERCOMPARISON (VIRI)?

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**ABSTRACT.** The issue of comparability of measurements (and thus bias, accuracy, and precision of measurement) from diverse laboratories is one which has been the focus of some attention both within the radiocarbon community and the wider user communities. As a result, the <sup>14</sup>C community has undertaken a widescale, far-reaching, and evolving program of inter-comparisons, to the benefit of laboratories and users alike. The benefit to the users is, however, indirect, since the <sup>14</sup>C inter-comparisons have not been used to generate “league tables” of performance, but rather to allow individual laboratories to check procedures and modify them as required.

The historical progression of <sup>14</sup>C laboratory intercomparisons from the Third (TIRI, completed in 1995, Gulliksen and Scott 1995) and Fourth (FIRI, completed in 2000, Scott 2003; Boaretto et al. 2000; Bryant et al. 2002) suggests that a Fifth (VIRI) should also be expected. We describe the plans for VIRI.

### INTRODUCTION

Radiocarbon laboratories continue to routinely operate quality assurance (QA) procedures, within which intercomparisons such as the Fourth International Radiocarbon Intercomparison (FIRI) formed an integral part.

Users, however, continue to express a desire to see evidence of <sup>14</sup>C measurement quality in general, and specifically, a hope for improvements in the precision of results allied to the ability to measure smaller and older samples. They often also wish to construct and make inferences based on assemblages of dates measured in different laboratories and possibly at different times.

Programs such as TIRI (the Third Radiocarbon Intercomparison) and FIRI operate in addition to any within-laboratory procedures for QA. They provide an independent check on the comparability of measurements and it is clear that, even with the increased availability of reference materials, laboratories still benefit from participation.

Criticisms of the design of TIRI and FIRI have included:

- The need for the measurements to be made over a relatively short period of time (hence, the workload within the laboratory is compromised);
- The fact that the intercomparisons provide only a snap-shot in time;
- That the samples are not anonymous but that laboratories are.

### THE PAST (BRIEFLY)

Long and Kalin (1990) stressed that it was “incumbent on individual laboratories to engage in a formal programme of quality assurance.” Polach (1989) noted that “internal checking needs suitable quality control and reference materials.” The quality of the measurement is determined by the laboratory, precise, and accurate measurement requires traceability to <sup>14</sup>C community-agreed reference materials

In the past laboratory intercomparisons, many of the samples have been natural samples, e.g. in 1982, International Study Group (ISG 1983), a floating chronology of 8 tree ring samples was used, with a date range of 4800–5200 BP. In 1990, in the International Collaborative Study (Scott et al.

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1990), both natural and artificial materials, including dendro-dated wood, the activities of which were less than 3 half-lives were used. In 1992, the International Atomic Energy Agency (Rozanski et al. 1992) created a set of secondary standards based on natural materials, the activities of which spanned background to modern. Finally in 1995 and 1999, TIRI and FIRI used natural materials, including dendro-dated wood, the activities of which spanned background to modern.

Typically, such studies have involved 10–20 analyses, often concentrated in a single year. FIRI required 10 analyses completed within one year; TIRI provided 6 core and 7 optional samples and a one-year window for core analyses; ICS had 3 experimental stages spread over 3 years, involving 4 samples in year 1, 6 samples in year 2, and 8 samples in year 3.

These intercomparisons showed evidence of broad comparability among laboratories but also some evidence of more variability than expected. Consensus values for the materials were derived and some reference materials were archived.

### **PLANS FOR A NEW INTERCOMPARISON PROGRAM**

It is clear that there is a need for continuing “routine” QA checks using reference materials (indeed, users expect this). Thus, it is important that a program continue with identification and testing of new, appropriate  $^{14}\text{C}$  reference materials, as part of its QA role. The proposed design and organization for VIRI is intended to address some of the criticisms, while retaining some of the important features of TIRI and FIRI, namely using natural samples, previously homogenized and tested, and the anonymity of participating laboratories to ensure that league-tables of laboratories are not created.

The design issues which must be considered include the selection of materials, the inclusion of duplicates for a precision check, and the use of known-age material as an accuracy check.

#### **Materials**

We propose that the materials should be of natural origin and span the applied  $^{14}\text{C}$  timescale. Materials to be used include bone, wood, seeds, barley mash, shells, and peat (whole and humic acid extract). It is planned that for each material, several samples of different  $^{14}\text{C}$  activities will be provided.

#### **Timescale**

To avoid the spot-check nature of TIRI and FIRI, we propose that VIRI will be a 4-year project, starting in 2004. There will be a rolling measurement commitment, with samples distributed regularly throughout the 4-year period. Three or 4 samples would be distributed in each of years 1–3 and in year 4, a more general intercomparison would be organized, including duplicates and with up to 8 samples. Each year, a particular material would be the focus of testing. Some samples will only be available for AMS measurement.

At the end of each year, laboratories would receive a detailed report so that any operational corrections could be made and the final (intercomparison) phase would be tied into a major AMS/ $^{14}\text{C}$  conference.

### **CONCLUSIONS**

QA is of fundamental importance to laboratories and users and the program of intercomparisons is seen (within the  $^{14}\text{C}$  and user communities) as an important part of the QA process. A new laboratory intercomparison program (VIRI) will start in 2004. VIRI will be a rolling and ongoing program, with a small number of samples being dispatched to participating laboratories each year. The fre-

quency and number of samples in VIRI are still to be finalized after consultation with the community, but this short note summarizes the current plans.

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